RAPID PROTOTYPING WITH DIRECT DEPOSITION OF METAL

Fernando Ribeiro
Universidade do Minho
Departamento de Electronica Industrial
4800 Guimarães
PORTUGAL

In the last three years a Rapid Prototyping process involving direct deposition of metal had been under development (as a PhD research) at Cranfield University. The process entails the use of a Gas Metal Arc fusion welding robot which deposits successive layers of metal in such way that it forms a 3D solid component, as briefly described by Ribeiro in [1].

After having drawn the component in a CAD, a slicing 'add-on' of the CAD program (developed by the author) is implemented to produce the desired layers which will form the robot program. It is also necessary to enter additional data to indicate the bead geometry and the material used. The welding parameters are automatically generated by the program in order to achieve the required bead geometry and stable operating parameters. These parameters were derived from welding studies carried out by Norrish [2] and parametric equations generated by Ogunbiyi and Norrish [3]. The robot program is automatically generated and can be simulated with the use of a robot simulation program to check for collisions or other problems such as access. The robot program may be modified if necessary then compiled and downloaded to the robot.

The main advantages of the slicing program developed is that the slices are automatically created, the ARLA robot program is completely automatically generated and it is not essential to use a robot simulation package to test it, although simulation can be used to save on line time.

The reason for making a prototype, should not only be to visualise it but also to be usable to test and assess it in its final function. Therefore, it is important to make the prototype with the same material used in the real and final component. This technique can be used to make not only the prototype but also the final component with the desired metal. Therefore, this represents also a new production technique more suitable for low volume production.

Depending on the complexity of the component, the time from drawing the component to being ready to press the robot start button to build the it can take less than a couple of hours.

Several test components were produced with good characteristics and perfectly acceptable surface finishing (a couple of those components can be seen in Figure 1 and Figure 2).

Another advantage with this new technique is that different metals can be used during the build up of the component to achieve different structural characteristics in different parts of the same component. This would not be possible with casting. The welding can be stopped at any time, the filler material changed, and the welding started again. The time to change the wire is very short.

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[1] RIBEIRO, A. F. M., NORRISH, J. AND MCMASTER R., "*Practical case of Rapid Prototyping using Gas Metal Arc Welding*", 5th International Conference on Computer Technology in Welding, Paris, France, 15-16 June 1994.

[2] Norrish, J., "*Advanced Welding Processes*", Institute of Physics Publishing, 1992.

[3] NORRISH, J., Ogunbiyi B., "*An Adaptive Quality Control concept for robotic GMA Welding*", 5th International Conference on Computer Technology in Welding, Paris, France, 15-16 June 1994.

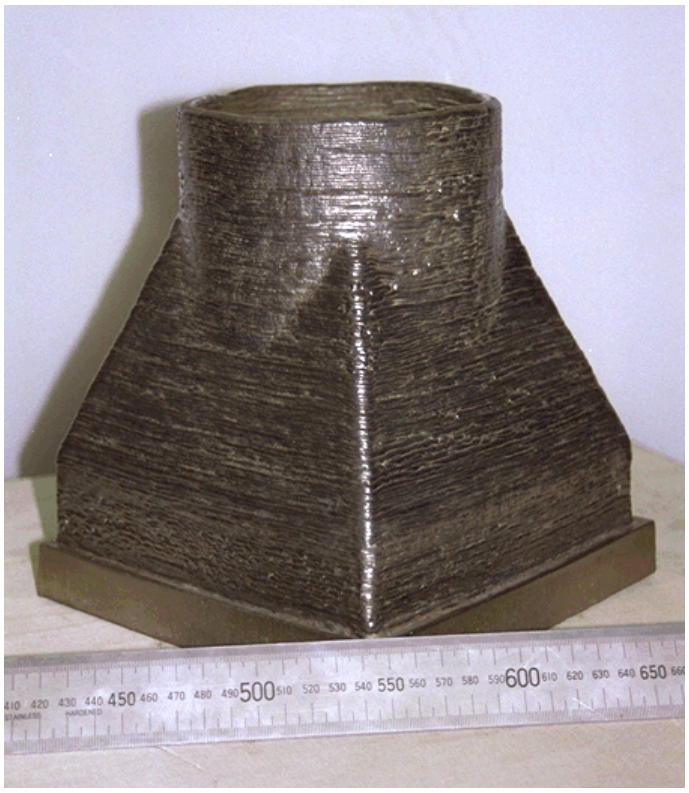

Figure 1 - ‘Square to round’ shape


Figure 2 - ‘Pint’ glass